Teenagers, Screens and Social Media: A Narrative Review of Reviews and Key Studies

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Abstract

In light of growing concerns about an increasingly digital adolescence, the academic field investigating how digital technologies affect adolescents' psychological well-being is growing rapidly. In the last years, much research has amassed, and this has been summarised in over 80 systematic reviews and meta-analyses. When examining these reviews, it becomes evident that the research field is dominated by cross-sectional work that is generally of a low quality standard. While research has highlighted the importance of differentiating between different types of digital technology use (e.g. active versus passive use or variations in self-presentation), many studies do not consider such necessary nuances. These limitations aside, the association between digital technology use, or social media use in particular, and psychological well-being is – on average – negative but very small. The size of this association is further decreased when examining studies that are particularly transparent. Furthermore, the direction of the link between digital technology use and well-being is still unclear: effects have been found to exist in both directions and there has been little work done to rule out potential confounders. Reviewing the last decade of reviews in the area, it is evident that the research field needs to refocus on improving transparency, interpreting effect sizes and changing measurement. It also needs to show a greater appreciation for the individual differences that will inherently shape each adolescent's reaction to digital technologies.

Keywords: digital technology use, social media, screen time, well-being, adolescents, review

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Adolescents currently growing up around the world are part of a unique generation. They have matured in an increasingly digitalised world where the use of digital screens is intensive and pervasive. The widespread interest into how this might be affecting them has led to the rapid accrual of academic work mapping potential links between time spent on digital screens and well-being outcomes. Following close behind the production of novel research, there has been a rise in systematic reviews and meta-analyses examining the impact of digital technology use (Dickson et al., 2018). Reviewing these reviews provides a unique point of insight into how different academic sources currently view the debate about the use of digital technologies. In this narrative review I therefore set out to examine both the broad range of systematic reviews and meta-analyses in this area (e.g. Hancock, Liu, French, Luo, & Mieczkowski, 2019; Carson et al., 2016), while complementing these with key studies unique in terms of their methodological rigor or experimental design (e.g. Allcott et al., 2019; Burke & Kraut, 2016; Orben et al., 2019). In light of the increasing need to differentiate between different types of digital technology use, part of my review will also focus on social media use in particular. What becomes evident when reviewing the literature, is the lack of clear cut evidence for a link between digital technology use and well-being, partly driven by a lack of high-quality research in the area. The review therefore concludes with concrete suggestions about how research could improve in future.

Digital Technology and Social Media

Most concerns about digital technologies, whether substantiated by evidence (Bell, Bishop, & Przybylski, 2015) or not (Greenfield, 2014), focus on so-called "screen time". Screen time is the amount of time a user spends interacting with screens during a specific time frame. The amount of screen time engaged with has risen in the past years, while the amount of time spent solely watching TV has fallen (Ofcom, 2019). Technology use patterns

are therefore changing from very distinct uses like TV viewing, to more diverse uses of screens throughout the day. While technologies like radio (Preston, 1941) or television (Strasburger, 1989) only support a small number of activities, digital devices such as smartphones or tablets are now the host of an increasingly diverse array of activities ranging from radio and television, to gaming, reading and social media browsing (Grimes, Anderson, & Bergen, 2008, p. 41). The widespread focus on screen time as the measure of digital technology use can therefore be explained by our increasing inability to differentiate between various forms of screen activities, making "screen time" a helpful umbrella term when voicing concerns about an increasingly digital world. The current review will therefore examine digital technology use effects through the lens of screen time.

I will, however, also complement this by reviewing evidence considering social media use in particular. Social media has become the recent focus of technology concerns as it allows for a more mobile, immersive and continuous form of technological engagement. Social media completes the erasure of the medium as it is inherently diverse and ever-changing: its content is highly individualised and can differ from person-to-person on an hour-by-hour basis. The diversity of social media, and its inherently social nature, makes it attractive to younger generations. In the UK, 69% of twelve to fifteen-year-olds now have a social media profile (Ofcom, 2019).

Current Evidence

"There is, as yet, no scientific consensus on the impact of screen-based lifestyles on the mental health of young people" (Frith, 2017). Yet there have been well over 80 systematic reviews and meta-analysis published that examine this link in a range of populations (Dickson et al., 2018). This number is bound to increase further, as the production of evidence in the area is still advancing at accelerating speeds. This narrative review aims to provide an important overview of the conclusions of all these attempts at research synthesis.

Review Methodology

To obtain a complete list of all systematic reviews and meta-analyses conducted on the link between digital technology use, social media use and adolescent well-being to date, I utilised the work done by Dickson and colleagues. They were commissioned by the UKs Chief Medical Officers to undergo a scoping exercise: creating a systematic map that pinpoints all current systematic reviews that considered screen time effects (Dickson et al., 2018). The systematic map was established with a PRISMA compliant systematic search of 12 bibliographic databases completed in August 2018 (for details see Dickson et al., 2018). The article titles and abstracts were screened to ensure four inclusion concepts were present: "1) children, young people or young adults; 2) cyberbullying, social media, online social interaction, online gaming, internet use or screen-time; 3) mental health, wellbeing, risk-taking behavior or emotional outcomes, or cyberbullying; 4) systematic reviews", i.e. they searched two databases and reported inclusion criteria (Dickson et al., 2018).

The mapping exercise went on to examine the quality of the reviews highlighted using an adapted version of the AMSTAR 2 criteria. Low risk of bias reviews needed to score a "yes" or "partial yes" on the six evaluation criteria:

a) Explicitly reporting their research questions and inclusion criteria

b) Using a comprehensive literature search strategy

c) Screening for duplicates

d) Listing excluded studies and why they were excluded

e) Describing included studies in detail

f) Evaluating the quality of included studies

The studies were of medium risk if they failed to include (f), while if they failed to include (a-e) they were assigned high risk. In this review I will not consider those reviews of medium or high risk (Dickson et al., 2018). This is important, because many studies in the area of screen time research are of particularly low quality and this needs to be noted and

considered by the corresponding systematic reviews.

Because the review was completed almost a year previously, I complemented the studies with a personal literature search of additional systematic reviews and meta-analyses published until May 2019. Due to the current value of these additional studies, I included them even if they did not achieve the low bias standards. To focus the narrative review presented here, I also excluded those reviews specifically focused on sexting, gaming, aggressive behaviour, internet addiction or those that only examined a specific sub-population (e.g. Rice, Haynes, Royce, & Thompson, 2016; Mitrofan, Paul, & Spencer, 2009; Wang, Yao, Zhou, Liu, & Lv, 2017), leaving 23 reviews to be included.

Having brought together a comprehensive corpus of reviews, I employed a narrative analytic approach with both *top-down* and *bottom-up* components. The former was structured around pre-determined research questions: what is a) the nature and b) the magnitude of relations found linking digital technology or social media use with well-being? As the nature of well-being was often ill-defined in the systematic reviews examined, I treated it as a range of measures. These included mental health and psychosocial outcomes like depression, support from social surroundings, social connections, satisfaction with life, anxiety, self-esteem and loneliness. I also employed a bottom-up approach, summarising particularly high-quality single studies in the field to highlight important areas of improvement. Having gathered a corpus of innovative studies through detailed reading of the reviews and my literature search, I split them into two core themes reported separately in this paper: improved research questions and improved methodologies. The narrative review therefore spans both top-down and bottom-up thematic components.

Systematic Reviews and Meta-Analyses: Digital Technologies

Systematic reviews in the field have routinely been confronted with a mixture of conflicting results. If averaged, these results provide evidence for a positive association between screen time and depressive symptoms (Hoare, Milton, Foster, & Allender, 2016). Reviews of studies on very young children found low to moderate quality evidence that TV use is linked to unfavourable outcomes (LeBlanc et al., 2012; Poitras et al., 2017). Systematic reviews examining older populations highlight that 1 in 8-12 studies find a null result, while the rest find a positive association between screen time and unfavourable psychological outcomes (Dennison, Sisson, & Morris, 2016; Tremblay et al., 2011). The relation is however not exceedingly clear. Some systematic reviews noted that a link between screen time and depressive symptoms only exists in cross-sectional and not in longitudinal studies (Liu, Wu, & Yao, 2016). In contrast, others find that it is the longitudinal studies that report a negative or null relation (Carson et al., 2016). To make sense of such conflicting reviews, the "very low" quality of research in the area must be taken into account (Carson et al., 2016; World Health Organisation, 2019). The conflicting results highlight that the evidence is still too weak to promote a uniform interpretation of the correlation between time spent on digital technologies and well-being outcomes.

The evidence base for the link between screen time and self-esteem is even weaker (Hoare et al., 2016). Just like for depression, there are many mixed results and slightly more studies find negative results (Carson et al., 2016). There has however been a randomised control trial showing that limiting television use increased self-esteem, which has been used by many systematic reviews to argue for a link (Tremblay et al., 2011). But one high-quality study on a specific intervention cannot make up for the many low-quality studies in the area that find mixed evidence.

Systematic Reviews and Meta-Analyses: Social Media

A systematic review of social media use and its links to depression, anxiety and distress highlights that this research literature is also conflicting (Keles, McCrae, & Grealish, 2019; Verduyn, Ybarra, Résibois, Jonides, & Kross, 2017). Furthermore, the evidence is low-quality and cross-sectional in nature (Frost & Rickwood, 2017; McCrae, Gettings, & Purssell, 2017). Reviews have found small correlations between social media use and depressive symptoms (Frost & Rickwood, 2017; Verduyn et al., 2017) that (if numerically provided) range from $r = 0.11$ (Yoon, Kleinman, Mertz, & Brannick, 2019) and $r = 0.13$ (McCrae et al., 2017) to $r = 0.17$ (Vahedi & Zannella, 2019). Another meta-analysis found no significant relationship between social media use and well-being ($r <$ -0.01, Hancock et al., 2019). Yet when this meta-analysis only examined studies of adolescents, this correlation did rise to levels similar to those found in other meta-analyses ($r =$ -0.07). The associations between social media use and well-being therefore range from about $r =$ -0.15 to $r =$ -0.10. It is however still unclear what such a small effect can tell us about well-being outcomes as social media use is inherently linked in complex ways with other aspects of life.

It is important to note here that other reviews have highlighted positive effects of social media. Some find that social media increases well-being, social communication, social support, social capital, authentic self-presentation and social connectedness while decreasing loneliness - even though these reviews routinely note that other studies have found exactly the opposite (Erfani & Abedin, 2018). One review concluded that those users who go to Facebook to promote social support and connection show lower levels of depressive symptoms (Frost & Rickwood, 2017). Other meta-analyses have also found that social media use increases social support (Liu et al., 2016) and that online media use increases perceived social resources ($r = 0.12$, Domahidi, 2018). One way to explain such a conflict is that different outcomes were examined. To arrive at an overarching conclusion, it might be necessary to differentiate the emotional and social outcomes of social media use (Bayer,

Ellison, Schoenebeck, Brady, & Falk, 2018). Social media might have a negative effect on emotional outcomes (e.g. mood or depression), but a positive effect on social outcomes (e.g. social connectedness). Yet even when examining the same outcome, positive and negative results can coexist because effects of social media can vary across users and time frames: it is therefore likely "that some users experience positive outcomes while others (and possibly the same users at different points in time) experience deleterious outcomes" (Frost & Rickwood, 2017).

Single studies

Research Question Improvements. Different uses and utilisations of social media might therefore be important to consider in order to obtain a better understanding of social media effects (Burke, Marlow, & Lento, 2010). In this review I will therefore highlight certain studies that have implemented a novel way of examining such a question, as they provide insight into how better research can be done in the area by differentiating between different types of uses. One major distinction is that between active and passive use, with active use representing activities like chatting, messaging and liking, while passive use includes activities like browsing newsfeeds, profiles or scrolling through photos and news items (Ellison, Steinfield, & Lampe, 2007). Researchers have hypothesised that active use increases social capital and connectedness, therefore positively affecting well-being, while passive use increases upward social comparisons and envy, in turn decreasing well-being (Verduyn et al., 2017). Studies have found that active use increases bonding social capital and decreases loneliness, while passive use doesn't have such positive outcomes (Burke et al., 2010). Experimental and experience sampling studies support this idea by highlighting that passive use decreases well-being, potentially by increasing envy (Verduyn et al., 2015). It is therefore important to differentiate between active and passive uses of social media. Yet results are still not clear cut. A study of 10,557 Facebook users whose Facebook data were

examined for three months prior to them filling out a questionnaire, found that active Facebook use did not influence well-being: only direct communication with close friends and family was linked to positive results (Burke & Kraut, 2016).

When considering different uses of social media, one also needs to examine the style of a user's online self-presentation. A qualitative synthesis of 21 observational studies examining Facebook self-presentation and mental health outcomes found that inauthentic self-presentation was related to low self-esteem and high social anxiety. More authentic or positive self-presentation was associated with increased levels of self-esteem and social support (Twomey & O'Reilly, 2017). A two-wave longitudinal study found that people who were more authentic on their profile reported higher levels of positive affect and life satisfaction, and lower levels of negative affect six months later (Reinecke & Trepte, 2014). In addition to active and passive use, a person's self-presentation might therefore be an important factor to consider in order to understand the link between social media use and well-being.

Methodological Improvements. There have been a variety of experimental and longitudinal studies that are worth mentioning because they provide ideas for methodological improvements. Many experimental studies have asked participants to refrain from using social media. They often find inconclusive effects, that however suggest a tentative positive association between limiting social media use and well-being. A study showed that those participants told to refrain from using Facebook for five days exhibit lower cortisol levels: but they also reported decreased life satisfaction (Vanman, Baker, & Tobin, 2018). In another study, those participants asked not to go on Facebook for a week showed increased life satisfaction, especially if they were heavy users (Tromholt, 2016). In contrast, a study asked undergraduates to limit their social media use to 10 minutes per day or continue as normal: both the experimental and the control group showed decreases in anxiety and fear of missing out, but only the experimental group showed additional decreases in loneliness and

depression (Hunt, Marx, Lison, & Young, 2018). A more extensive study of 2,897 participants where one group was told to deactivate Facebook for four weeks, found that the experimental group showed small increases in well-being measured retrospectively. There were however no changes in the well-being measures collected by experience sampling or loneliness reports (Allcott et al., 2019).

"Facebook detox" studies therefore find inherently conflicting results. Such conflicts could be the result of the studies' low quality. Many experimental designs did not limit all social media use and most studies found it difficult to obtain good levels of participant compliance (Allcott et al., 2019; Tromholt, 2016; Vanman et al., 2018). Furthermore, there is a potential for bias in participant selection: those potential participants who are not as reliant on social media to obtain positive outcomes might be more likely to take part in studies asking for them to give up social media.

There are also many longitudinal and experience sampling studies examining social media use and well-being. Some have found negative results on outcomes like life satisfaction (Kross et al., 2013). Others have found that those who communicate more frequently on social media are more satisfied with life (Dienlin, Masur, & Trepte, 2017) or have more positive emotions (Wenninger, Krasnova, & Buxmann, 2019). In contrast, other studies found no (or only a very small) association between social media use and life satisfaction (Orben et al., 2019; Utz & Breuer, 2016) or depression (Jelenchick, Eickhoff, & Moreno, 2013). Interestingly, effects might be dependent on the longitudinal time frame considered in the study: it was found that posting a status update increased positive affect after 10 minutes but not after 30 minutes or two weeks (Bayer et al., 2018).

Small Negative Associations between Screens, Social Media and Wellbeing

While the research area is filled with conflicting findings based on cross-sectional evidence, there is some common ground. Many studies and meta-analyses find a small negative association between social media use and well-being of about r = -0.15 to r = -0.10, while the correlations fall to about r = -0.10 to r = -0.05 in some work lauded as being more transparent (Orben & Przybylski, 2019b, 2019a). Correlations and observed effects in this ballpark have been shown in meta-analytic studies considering anxiety and depressive outcomes (e.g. McCrae et al., 2017; Hancock et al., 2019; Vahedi & Zannella, 2019; Yoon et al., 2019), but have also been found in longitudinal research (Bayer et al., 2018; Frison & Eggermont, 2017; Kross et al., 2013; Orben et al., 2019; Reinecke et al., 2018) and experimental work (Allcott et al., 2019). As mentioned above, it is still unclear what such a range of effects can tell us about well-being and how it is affected by social media use. This is because there are a range of third factors that can influence both variables, and there have been sources of bias not addressed properly in a literature that is largely cross-sectional and exploratory.

The same kind of effect size has, however, also been found bidirectionally: for social media use decreasing well-being and well-being decreasing social media use (Wang, Gaskin, Rost, & Gentile, 2018). The importance of bidirectional effects is clearly evident (Orben et al., 2019), but the results remain unclear. An early group of experimental and correlational studies found that while disconnection drives the use of Facebook, connection results from Facebook use (Sheldon, Abad, & Hinsch, 2011). This does not fall in line with those studies finding negative relations in both directions (Aalbers, McNally, Heeren, Wit, & Fried, 2018; Frison & Eggermont, 2017; Wang et al., 2018), only in the direction of social media use decreasing well-being (Kross et al., 2013) or only in the direction of loneliness leading to Facebook use (Song et al., 2014). It is therefore clear that more work considering bidirectional effects needs to be completed before true effects become evident. To start

finding common ground, research therefore needs to increase transparency, while doing more to interpret the size and importance of effects and highlight their bidirectionality.

New Challenges and Future Directions

The low quality and conflicting state of the literature highlights many areas of the research field that need to be improved further for research to successfully provide vital information to other academics and stakeholders like parents and policymakers. The future field should therefore focus on initiatives ranging from bettering transparency, to thinking about effect sizes, measurement and at-risk populations. If implemented, these would not only improve research quality, but would also lay the foundations for a more constructive research process that will have the potential to produce more coherent evidence.

Increased Transparency

Flexibility in how researchers analyse and report their data is an ingrained and substantive problem. Any researcher needs to make multiple decisions when analysing their data (e.g. what outliers to exclude; what control variables to add). When making these decisions while analysing their data, they can unconsciously or consciously choose those data analysis methods that lead them towards the result that they were expecting or hoping to find (Gelman & Loken, 2014). This can increase the false positive rate in a discipline, especially when there are cognitive biases and widespread pressures to publish positive results (Bishop, 2019; Wagenmakers, Wetzels, Borsboom, Maas, & Kievit, 2012). Researchers have therefore been advocating for more transparent disclosures of analytical pathways (Bishop, 2019; Simmons, Nelson, & Simonsohn, 2018; Stark, 2018) through preregistration and Registered Reports (Chambers, 2013, 2014; van't Veer & Giner-Sorolla, 2016; Wagenmakers et al., 2012). Preregistration entails registering the process of data

analysis before accessing the data - and before the data can bias analytical choices. Registered Reports further aim to remove publication bias by providing peer review prior to data collection (Chambers, 2014). Furthermore, methods like Specification Curve Analysis can be helpful for analysing secondary data (Orben & Przybylski, 2019b; Simonsohn, Simmons, & Nelson, 2015). Such initiatives have shown the potential for transparent research to better inform policy, the public and academia. Transparency therefore has the potential to hugely benefit the provision of evidence about new technologies.

Renewed Focus on Practical Significance

New approaches for communicating effect sizes are also important as statistically significant results are not always practically significant. To ensure that minute, but statistically significant, effects are not over-reported, researchers have suggested defining a Smallest Effect Size of Interest: the smallest possible effect that will be reported as practically "significant" in a study (Lakens, Scheel, & Isager, 2018). Defining such a value is however very difficult (Anvari & Lakens, 2019) and depends on the perspective that one takes about what populations will be affected (Rose, 2008). Alternatives to this include comparing the effect found to other more interpretable effects in the dataset (Orben & Przybylski, 2019b), or examining the size of effect that will lead to a noticeable change in the population's well-being (Orben & Przybylski, 2019a). All in all, it is increasingly clear that effective communication of effect sizes will become crucial for both academia and policy in times of research using increasingly large-scale data.

Retiring Screen Time and Better Measurement

It also needs to be noted that there has been increasing discontent about the measurement practices used in the area. Researchers argue that there are now the

psychometric tools available to move away from measuring self-reported screen time (Andrews, Ellis, Shaw, & Piwek, 2015; Ellis, 2019; Ellis et al., 2019; Wilcockson, Ellis, & Shaw, 2018), which is known to be a flawed measure of media effects (Scharkow, 2016). Better measurement of digital technology and social media use could lead to more exact and consistent results in the literature. Such measurement could include both passive experience sampling and tracking of exact features of use.To help provide this data, academic and political organisations need to endeavour to find ethical, transparent and controlled mechanisms for data held by social media corperations to be shared with researchers. This can further be paired with active experience sampling techniques, where certain questions (e.g. about well-being) are prompted after bouts of certain uses of technology (Masur, 2019). Such methods are also known as ambulatory assessment in other fields (Trull & Ebner-Priemer, 2013), which tracks people in their own environments, providing more natural and valid data about both self-report questionnaires and actual activities. While these methods come with both technological, ethical and legal challenges, they present some of the most promising avenues for future research. They crucially can both provide better data about uses and well-being, but also their interactions and time-dependencies - bringing researchers much closer towards understanding the possible causal relationships between the two.

The promise of exact tracking lies in the ability to track well-being in specific time frames and to differentiate different types of social media and technology use. This would allow screen time to be examined in more nuanced and diverse ways, distinguishing different activities and timings of use. It would enable researchers to home in on possible non-linear dose-response relationships between technology use and psychological outcomes, which have been shown in previous work (Hoare et al., 2016, 2016; Przybylski & Weinstein, 2017).

At-Risk Populations

Furthermore, there needs to be an increased focus on individual differences. This would be helped by the study of more diverse and rigorously recruited samples, as much of the current research is conducted on convenience samples or populations in the global north (Erfani & Abedin, 2018). More studies should also account for factors like gender or age. While age is not a routine focus of studies (Hancock et al., 2019), gender has been shown to be a predictive factor in recent work (Frison & Eggermont, 2016; Orben et al., 2019; Twenge, Joiner, Rogers, & Martin, 2017). To locate those adolescents who might be most vulnerable to the negative effects of digital technologies, a renewed focus on factors that might put adolescents at risk is needed. To pinpoint such risk factors, more research will have to focus on tracing the effects of technologies over more extensive periods of time. "Ultimately, our findings demonstrate the lack of a uniform overall 'Facebook effect" on individuals, and illustrate the need to build temporal and spatial components into future research on Facebook and the wider social media ecosystem.' (Bayer et al., 2018). It is therefore important to conduct more longitudinal work (Carson et al., 2016, 2016; Dickson et al., 2018; Frost & Rickwood, 2017) with more diverse time frames (Bayer et al., 2018) ranging from short-term experience sampling (Aalbers et al., 2018) to long-term annual studies (Wang et al., 2018).

Conclusion

In this narrative review I examined the previously completed systematic reviews and meta-analyses considering the effects of digital technology and social media use on well-being, and supplemented these with selected studies that illustrate new methodological and theoretical approaches. In all, they show that the research area examining these crucial questions does not deliver concrete results, but is instead weighed down by a lack of quality that causes the production of much conflicting evidence. Across the board a small negative

correlation between digital technology use and adolescent well-being can be located, but it is not clear whether this represents a clear causal relationship or an association driven by third factors. By implementing improvements to the research approach I proposed above, research investigating the effects of digital technologies should increase in transparency, consistency and efficiency. Therefore improving our measurement, diversifying our research focus and examining effect sizes might hold the key for producing results that provide more than conflicting evidence. In times of greatly accelerating technological innovation the demand for timely and high-quality research on whether and how new technological features are affecting the population will only increase. Improving the mostly stagnating and conflicting research area will, therefore, be crucial to ensure that science continues having a voice in future debates about novel technologies and their potential effects on society.

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